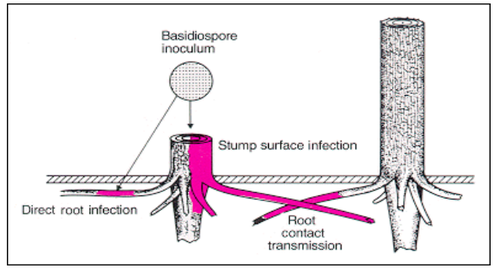
Annosum Root Rot

Biology: Infection most often occurs when basidiospores, produced by the fruit body, land and germinate on the surface of a freshly cut stump. This infection process creates a strong relationship between Annosum root disease and thinned stands.
Basidiospores are most often produced when the temperature is between 5º - 32º C (41º - 90º F) and can be carried in the wind over hundreds of miles; most spores are deposited within 90 meters (300 feet).
The fungus colonizes the stump tissue, moves into the root tissue and progresses from tree to tree via root contact at the rate of approximately 1-2m/yr (3.2- 6.5 ft/yr). Infection through root and lower stem wounds can also occur. This has been observed in Wisconsin on white pine regeneration in a red pine plantation.

Heterobasidion annosum degrades both the lignin and the cellulose and causes a stringy yellow decay in the roots and lower stem.



Infection occurs through freshly cut stump.
From: Annosus Root Rot in Eastern Conifers, K. Robbins, 1984. FIDL 76.

Stringy, yellow decay caused by *Heterobasidion annosum.*

Impact: Infected trees will have reduced height, shoot and diameter growth and thin foliage. These symptoms typically appear 2-3 years after a thinning. As decay advances through the root system and into the lower stem, the tree will become more susceptible to wind throw and eventually die. Red, jack and white pine seedlings and saplings in close proximity to infected overstory may also become infected. The number of infection centers in a stand can vary widely. Infection centers create gaps in the forest canopy where brush and early successional trees can regenerate.
Both Annosum root rot and red pine pocket mortality can occur in the same stand and even within the same pocket.

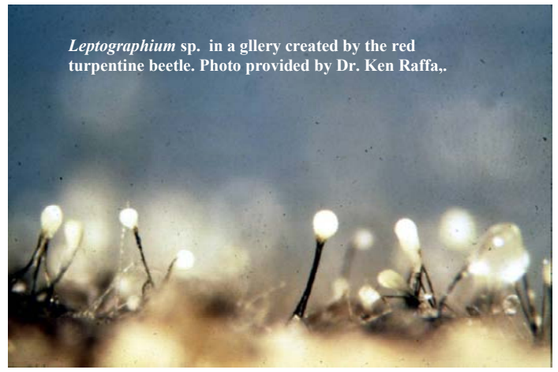
Infected white pine seedling with several *Heterobasidion annosum* fruit bodies.

Site Factors/Stand History: In the southeastern United States, **disease development is more common on land formerly used for agriculture and with a pH >6** than on old forest soils**. Sandy or sandy loam soils at least 30 cm (12 inches) deep, with good internal drainage and a low seasonal water table** are also considered sites **favorable for disease development.** The influence of site factors on disease progression has not yet been studied in Wisconsin. Annosum root rot is most damaging in plantation-grown conifers where thinnings provide infection courts (fresh stumps) and root grafts provide a pathway for Annosum to move from tree to tree.

Red Pine Pocket Mortality

Biology: Insect vectors including root collar weevil (*Hylobius radicis),* pales weevil (*H. pales)*, red turpentine beetle (*Dendroctonus valens)*, pitch-eating weevil *(Pachylobius picivorus)*, and *Hylastes porculus*, feed on freshly cut stumps, the lower stem and roots of red pine, transmitting the fungus *Leptographium terebrantis* and *L. procerum* into the lower stem and root system. Once established in the communal root system of a red pine plantation, **Leptographium spreads** to healthy trees via root connections. Trees infected with Leptographium are stressed by a decrease in water conduction and a decrease in the production of defensive compounds. These stressed trees continue to attract lower stem feeding beetles, particularly the red turpentine beetle. **Bark beetles** (*Ips pini* and *I. grandicollis)* are ultimately responsible for tree mortality

Red Turpentine Beetle, *Dendroctonus valens*.
Photo provided by Dr. Ken Raffa,



Leptographium sp. in a gllery created by the red turpentine beetle. Photo provided by Dr. Ken Raffa,.

Impact: Infected trees will have reduced height and diameter growth. As disease progresses and attacks by the red turpentine beetle increase, successful invasion by the pine bark beetle occurs. Infestation by the pine bark beetle kills the tree. Red pine pocket mortality has NOT been observed in jack or white pine plantations. White pine regeneration within pockets also appears to be unaffected by this syndrome. The number of infection centers in a stand can vary widely. Infection centers create gaps in the forest canopy where brush and early successional trees can regenerate.
Both Annosum root rot and red pine pocket mortality can occur in the same stand and even within the same pocket.

White pine regeneration in a red pine pocket.

Site Factors/Stand History: Studies attempting to identify site factors associated with red pine pocket mortality are ongoing. Red pine pocket mortality is a disease of plantation-grown red pine. Red pine pockets are more common in stands that have been thinned than in unthinned stands; root grafts provide a pathway for Leptographium to move from tree to tree.